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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/755,071	01/08/2001	Kie Y. Ahn	M4065.0415/P415	5118

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DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP
2101 L STREET NW
WASHINGTON, DC 20037-1526

EXAMINER
ECKERT II, GEORGE C

ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 05/22/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.	Applicant(s)
09/755,071	Ahn et al.
Examiner	**Art Unit**
George C. Eckert II	2815

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Mar 21, 2003*.

2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *1-28, 30, 31, 33-37, and 39-41* is/are pending in the application.

4a) Of the above, claim(s) *1-18* is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *19-28, 30, 31, 33-37, and 39-41* is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

a) ☐ The translation of the foreign language provisional application has been received.

15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____
4) ☐ Interview Summary (PTO-413) Paper No(s). _____
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Response to Amendment

1. Applicant's amendment dated March 21, 2003 in which claim 40 was amended has been entered of record.

Election/Restriction

2. Claims 1-18 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 5.

Claim Rejections - 35 U.S.C. § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless -
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.
>
> The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

3. Claims 19, 21, 22, 24, 25, 28 and 30 are rejected under 35 U.S.C. 102(e) as being anticipated by US 6,362,528 to Anand. Anand teaches, with reference to figures 8-19, a dual damascene structure comprising:

a semiconductor substrate 11;

a first insulating layer 25 provided over the substrate;

a metal layer 17b provided within the first insulating layer;

at least another or second insulating layer 18 provided over the metal layer;

a via 19a situated within the second insulating layer 18 and extending to at least a portion of the metal layer, the via being lined with a titanium-silicon-nitride layer 20a and filled with a copper material 20b (col. 13, lines 11-13 and lines 17-18);

a third insulating layer 27 located over the second insulating layer;

a trench 19b situated within the third insulating layer and extending to the via, the trench being lined with the titanium-silicon-nitride and filled with copper (col. 13, lines 11-13, 17-18).

Regarding the limitation that the titanium-silicon-nitride layer which lines the via is formed by an organo-metallic-atomic deposited process, such limitation does not further define the structure as instantly claimed, nor serve to distinguish over Anand. Note that a "product by process" claim is directed to the product per se, no matter how actually made, In re Hirao, 190 USPQ 15 at 17 (footnote 3). See also In re Brown, 173 USPQ 685; In re Luck, 177 USPQ 523; In re Fessmann, 180 USPQ 324; In re Avery, 186 USPQ 161; In re Wertheim, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); In re Marosi et al, 218 USPQ 289; and particularly In re Thorpe, 227 USPQ 964, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a

product, whether claimed in "product by process" claims or not. Note that applicant has the burden of proof in such cases, as the above caselaw make clear.

With regard to claims 21 and 22, Anand teaches that the another or second insulating layer 18 is formed of silicon dioxide and is 1 μm or 10,000 Å thick (col. 12, lines 35-37). With regard to claims 24 and 25, Anand teaches that the third insulating layer 27 is formed of silicon dioxide and is 6,000 Å thick (col. 11, lines 41-42, lines 48-50, see also col. 11, lines 52-54). With regard to claim 28, Anand teaches that the copper material is copper (col. 13, lines 17-18). With regard to claim 30, Anand teaches that the substrate is silicon (col. 11, line 32).

Claim Rejections - 35 U.S.C. § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 20, 23, 31, 33, 34, 37 and 39-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anand in view of US 6,093,966 to Venkatraman et al. (of record). Anand teaches the device of claim 19 as discussed above, which also reads on limitations of claims 31 and 40, but does not teach that the insulating layers may be formed of polyimide. Venkatraman et al. teach that an insulating layer may be formed of silicon dioxide or polyimide (col. 4, lines 39-54). With regard to claim 40, Anand teaches that the integrated circuit which includes the dual

damascene structure is formed as part of a ULSI (ultra large scale integrated circuit) which is considered a processor. Anand also teaches that the integrated circuit having the damascene layers is formed on the same chip as the processor (see generally figures 21-24).

Anand and Venkatraman et al. are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to use polyimide as the insulator of Anand. The motivation for doing so is that such a material has a low dielectric constant such that parasitic capacitance between conductors is reduced. Therefore, it would have been obvious to combine Anand with Venkatraman et al. to obtain the invention of claims 20, 23, 31, 33, 34, 37 and 39-41.

5. Claims 26 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anand as applied to claims 19 and 31 above, and further in view of *Ti-Si-N Diffusion Barriers Between Silicon and Copper* to J. S. Reid et al. Anand taught the device of claims 19 and 31 but did not teach that the Ti-Si-N liner layer is between 50 - 200 Å or specifically 100 Å thick. Reid et al. teach, on page 299 in the right hand column, first full paragraph, that a layer of Ti-Si-N may be formed at a thickness of 10 nm (100 Å).

Anand and Reid et al. are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form the Ti-Si-N layer to a thickness of 100 Å. The motivation for doing so, as is taught by Reid et al., is that such thickness is sufficient to prevent copper migration up to a temperature of

650°C. Therefore, it would have been obvious to combine Reid et al. with Anand to obtain the invention of claims 26 and 27.

6. Claims 35 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anand in view of Venkatraman et al. and Reid et al. Anand and Venkatraman et al. made obvious the device of claim 31 as discussed above. However, they did not teach that the Ti-Si-N liner layer is between 50 - 200 Å or specifically 100 Å thick. Reid et al. teach that a layer of Ti-Si-N may be formed at a thickness of 10 nm (100 Å).

Anand and Venkatraman et al. are combinable with Reid et al. because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form the Ti-Si-N layer to a thickness of 100 Å. The motivation for doing so, as is taught by Reid et al., is that such thickness is sufficient to prevent copper migration up to a temperature of 650°C. Therefore, it would have been obvious to combine Reid et al. with Anand and Venkatraman et al. to obtain the invention of claims 35 and 36.

Response to Arguments

7. Applicant's arguments filed March 21, 2003 have been considered but are not persuasive. Applicant argues that the limitation "organo-metallic-atomic deposited titanium-silicon-nitride layer" is not a product-by-process limitation but is rather "a *resulting structure* having defined and distinct characteristics" (*Emphasis* in original). This argument is not persuasive as the resulting

structure of the limitation is nothing more than a Ti-Si-N layer formed by a organo-metallic-atomic process. The limitation lacks any defined and distinct characteristics beyond the Ti-Si-N layer taught by Anand. Applicant cites *Hazani v. U.S. Int'l Trade Comm'n*, 126 F.3d 1473 (Fed. Cir. 1997) for support but the case is not dispositive to the instant limitation.

In *Hazani*, the Federal Circuit did find that the limitation "chemically engraved," read in context with the remaining claim limitations, described a product "more by its structure than by the process used to obtain it." However, it is not clear what test comes from *Hazani* to determine if the instant limitation is a product-by-process limitation or how *Hazani* is otherwise applicable. In *Hazani*, the limitation in question read "a first plate . . . having a chemically engraved surface of a pre-determined pattern." The limitation of "chemically engraved" however, is not so much a limitation on how the "first plate" was made but on how it was treated or processed *subsequent* to its formation. As such, the court looked to the specification to determine what weight to give the limitation "chemically engraved." There, they found that "chemically engraved" meant "textured with asperities." Because they further found that the process of chemically engraving was not structurally different from the prior art, the limitation was anticipated.

In the instant application however, the court's findings in *Hazani* are not applicable. First, "organo-metallic-atomic deposited" does not refer to a treatment applied to the Ti-Si-N layer *after* it is formed but is instead the process by which the layer is actually formed. Also, the instant specification cannot be used as it was in *Hazani* because it nowhere teaches what *structure* is defined by the limitation "organo-metallic-atomic deposited." Rather, the specification, in the

paragraph bridging pages 9-10, merely teaches that the *structure* of Ti-Si-N formed by the *process* of metal-organic-atomic deposition, has certain properties. However, the specification is silent as to what specific structure is obtained by an organo-metallic-atomic process that *distinguishes* this Ti-Si-N layer from any other. Thus, the limitation "organo-metallic-atomic deposited" read in context with the remaining claim limitations and as evidenced by the specification, indicates clearly that the limitation is a product-by-process limitation because it describes the product by the process used to obtain it.

Applicant's arguments support the same conclusion. In applicant's response dated August 26, 2002, applicant argues that Anand does not anticipate the instant "organo-metallic-atomic deposited titanium-silicon-nitride layer" limitation because Anand's layer is formed "'by the CVD *method* or PVD *method*' [citation omitted] and not by organo-metallic atomic layer *deposition*" (*emphasis added*). This clearly argues that the structures are different based on the different *processes* used to make them. Nowhere are any structural differences established. Moreover, in the most recent response applicant again argues the failings of the rejection because Anand teaches a Ti-Si-N layer formed "*by the CVD method or PVD method*" (*Emphasis in original*). It is unclear how this argues anything but support for the assertion that the limitation is a product-by-process limitation. Simply put, the limitation claims the structure of a Ti-Si-N layer formed by an organo-metallic-atomic deposition *process*; it includes no specific structure aside from the layer of Ti-Si-N itself. As such, and as made clear in the previous rejection, because the patentability of

a product does not depend on its method of production when the final product is the same as a product in the prior art, the rejection is maintained. *In re Thorpe*, 777 F.2d 695 (Fed. Cir. 1985).

Alternatively, if application of *Hazani* is on point and the limitation should be characterized as a pure product claim, it is still not clear what product is claimed beyond a Ti-Si-N layer. The limitation "organo-metallic-atomic deposited" itself adds nothing insofar as structure, nor does reading the limitation in context add structural weight. Not even does the impermissible importation of limitations from the specification into the claim assist in differentiating the structure. The specification merely states that Ti-Si-N layers formed by organo-metallic-atomic deposition "prevent the diffusion of copper at temperatures up to 800°C for 60 minutes." However, this explanation does not structurally distinguish over that taught by Anand.

If it is applicant's argument that a Ti-Si-N layer formed by an organo-metallic-atomic deposition *process* results in a *structurally* different layer than that taught by Anand, this also is not persuasive. At best, applicant has merely made an assertion as to a strutural difference but no supporting evidence has been offered. As made clear in the outstanding Office action, a limitation claimed in product-by-process form carries with it the risk that once the PTO has established a basis for rejection, the burden shifts to applicant to come forward with evidence establishing an unobvious difference. *In re Marosi*, 710 F.2d 798 (Fed. Cir. 1983). Because no evidence has been offered as to a difference between the Ti-Si-N layer of Anand and that of the instant invention, the rejection is maintained.

Regarding the remaining rejections under 35 USC 103, applicant argues that Anand in combination with Venkatraman et al. fail to teach an organo-metallic-atomic deposited titanium-silicon-nitride layer. However, as discussed above, this limitation is considered a product-by-process limitation that does not distinguish over the Ti-Si-N layer of Anand. As such, the arguments are not persuasive. Applicant also argues that Anand fails to teach an insulating layer formed of polyimide, spin-on-polymers, etc. However, this limitation is taught and made obvious by Venkatraman et al. and the arguments as to these claims are not persuasive. Finally, applicant argues that the rejections over Reid et al. must also fail as Reid does not disclose an organo-metallic-atomic deposited titanium-silicon-nitride layer. However, because this limitation is considered met by Anand, the arguments are not persuasive and the rejection is maintained.

Conclusion

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however,

will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to George C. Eckert II whose telephone number is (703) 305-2752.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mr. Eddie Lee can be reached on (703) 308-1690. The fax phone number for this Group is (703) 308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

GEORGE ECKERT
PRIMARY EXAMINER

GCE
May 19, 2003